

We claim:

1. A passive alignment fiber optic connection system, comprising:
2 a connector module having a plurality of fiber optic fibers having ends terminating
at a face of said connector module;
4 a substrate module having a plurality of waveguides having ends terminating at a
face of said substrate module;
6 at least two pins projecting from one of said modules at pin locations;
at least two pin passages within another of said modules at pin locations and
8 through said face thereof, respective said pin passages being sized, shaped and positioned
to receive respective said projecting pins; and
10 said ends of said fiber optic fibers are spaced from one another and from said pin
locations of the connector module in accordance with a predetermined alignment pattern,
12 and said ends of said waveguides are spaced from one another and from said pin locations
of the substrate module in accordance with said predetermined alignment pattern,
14 whereby each of said respective waveguides optically align with each of said respective
fibers when said modules are attached together.

2. The fiber optic connection system in accordance with claim 1, wherein said
2 respective ends of the fiber optic fibers are in center-to-center alignment with said
respective ends of the waveguides.

3. The fiber optic connection system in accordance with claim 1, wherein said
2 respective ends of the fiber optic fibers are flush with said face of the connector module.

4. The fiber optic connection system in accordance with claim 1, wherein said
2 respective ends of the waveguides are flush with said face of the substrate module.

2 5. The fiber optic connection system in accordance with claim 1, wherein said
respective ends of the fiber optic fibers are closely spaced from said respective ends of
the waveguides.

2 6. The fiber optic connection system in accordance with claim 1, wherein said
respective ends of the fiber optic fibers are in contact with said respective ends of the
waveguides.

2 7. The fiber optic connection system in accordance with claim 1, wherein said
face of the connector is generally perpendicular to respective lengths of said fiber optic
fibers including said ends of the respective fibers.

2 8. The fiber optic connection system in accordance with claim 1, wherein said
face of the substrate is generally perpendicular to respective lengths of said waveguides
including said ends of the respective waveguides.

2 9. The fiber optic connection system in accordance with claim 1, wherein said
respective ends of said fiber optic fibers are closely spaced from and in center-to-center
alignment with said respective ends of said waveguides.

2 10. The fiber optic connection system in accordance with claim 1, wherein said
respective ends of said fiber optic fibers contact said respective ends of said waveguides
and are in center-to-center alignment therewith.

2 11. The fiber optic connection system in accordance with claim 1, wherein:
said face of the connector is generally perpendicular to respective lengths of said
4 fiber optic fibers including said ends of the respective fibers;
said face of the substrate is generally perpendicular to respective lengths of said
6 waveguides including said ends of the respective waveguides; and
said respective ends of said fiber optic fibers are in center-to-center alignment
8 with said respective ends of said waveguides.

2 *Sub 116* 12. The fiber optic connection system in accordance with claim 1, wherein said
system is for dense wavelength division multiplexing products.

2 13. The fiber optic connection system in accordance with claim 1, wherein said
substrate contains no fiber optic fibers.

2 14. The fiber optic connection system in accordance with claim 1, wherein said
substrate module is devoid of grooves for receiving fiber optic fibers from the connector
module.

2 *Sub 117* 15. The fiber optic connection system in accordance with claim 1, wherein said
system has more than one said connector, said substrate has an input component and an
4 output component, one said connector is provided for attachment with said input
component, and another said connector is provided for attachment with said output
component.

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4 16. The fiber optic connection system in accordance with claim 1, wherein said substrate includes two wafers assembled together, and prior to assembly one said wafer has said plurality of waveguides while the other said wafer has a plurality of channels which accommodate said plurality of waveguides when the wafers are assembled together.

2 17. The fiber optic connection system in accordance with claim 1, wherein said substrate includes two wafers assembled together, and prior to assembly one said wafer has said plurality of waveguides positioned thereon.

2 18. The fiber optic connection system in accordance with claim 16, wherein said substrate contains no fiber optic fibers.

2 19. The fiber optic connection system in accordance with claim 18, wherein said substrate is devoid of grooves for receiving fiber optic fibers from the connector module.

2 20. The fiber optic connection system in accordance with claim 16, wherein said channels of the substrate contain a filler which accommodates said waveguides.

2 21. A passive alignment fiber optic substrate module, comprising:
a substrate body having a face;
4 a plurality of waveguides which are within said substrate body and which have
ends terminating at said face of the substrate module;
6 at least two pin locations; and
said ends of said waveguides are spaced from one another and from said pin
8 locations of the substrate module in accordance with a predetermined alignment pattern
which is adapted to coincide with fiber optic fibers and pin locations of another
10 component.

2 22. The fiber optic substrate module in accordance with claim 21, wherein said
predetermined alignment pattern coincides with an alignment pattern of a connector
4 module having at least two pin locations and a plurality of fiber optic fibers having ends
terminating at a face thereof, whereby each of said respective waveguides are adapted to
optically align with each respective fiber ends.

2 23. The fiber optic substrate module in accordance with claim 21, wherein said
alignment pattern is center-to-center alignment.

2 24. The fiber optic substrate module in accordance with claim 21, wherein said
respective ends of the waveguides are flush with said face of the substrate module.

2 25. The fiber optic substrate module in accordance with claim 21, wherein said
face of the substrate is generally perpendicular to respective lengths of said waveguides
including said ends of the respective waveguides.

2 26. The fiber optic substrate module in accordance with claim 21, wherein said
system is for dense wavelength division multiplexing products.

27. The fiber optic substrate module in accordance with claim 21, wherein said
2 substrate contains no fiber optic fibers.

28. The fiber optic substrate module in accordance with claim 21, wherein said
2 substrate module is devoid of grooves for receiving fiber optic fibers.

29. The fiber optic substrate module in accordance with claim 21, wherein said
2 body includes two wafers assembled together, and prior to assembly one said wafer has
4 said plurality of waveguides while the other said wafer has a plurality of channels which
5 accommodate said plurality of waveguides when the wafers are assembled together.

30. The fiber optic substrate module in accordance with claim 21, wherein said
2 body includes two wafers assembled together, and prior to assembly one said wafer has
said plurality of waveguides.

31. The fiber optic substrate module in accordance with claim 29, wherein said
2 body contains no fiber optic fibers.

32. The fiber optic substrate module in accordance with claim 29, wherein said
2 channels of the body contain a filler which accommodates said waveguides.

2 33. A method for passive optical alignment of a fiber optic connection system,
comprising the steps of:

4 providing a connector module having a plurality of fiber optic fibers having ends
terminating at a face of the connector module and having at least two pin locations;

6 spacing said ends of the fiber optic fibers and said pin locations in accordance
with a predetermined alignment pattern;

8 providing a substrate module having a plurality of waveguides having ends
terminating at a face of the substrate module and having at least two pin locations;

10 spacing said ends of the waveguides from one another and from said pin locations
of the substrate module in accordance with said predetermined alignment pattern; and

2 attaching the connector module and substrate module together in order to thereby
automatically optically align each of the respective waveguides with each of the
4 respective fibers when the modules are attached together.

2 34. The method in accordance with claim 33, wherein said attaching step
automatically aligns respective ends of the fiber optic fibers in center-to-center alignment
with respective ends of the waveguides.

2 35. The method in accordance with claim 33, wherein said providing steps result
in the ends of the fiber optic fibers being flush with the face of the connector module and
the ends of the waveguides being flush with the face of the substrate module.

2 36. The method in accordance with claim 33, wherein after said attaching step the
respective ends of the fiber optic fibers are closely spaced from the respective ends of the
waveguides.

2 37. The method in accordance with claim 33, wherein after said attaching step the
respective ends of the fiber optic fibers are in contact with said respective ends of the
waveguides.

2 38. The method in accordance with claim 33, wherein said attachment step results
in the respective ends of the fiber optic fibers being closely spaced from and in center-to-
center alignment with the respective ends of the waveguides.

2 39. The method in accordance with claim 33, wherein the respective ends of the
fiber optic fibers contact the respective ends of said waveguides and are in center-to-
center alignment therewith.

2 40. The method in accordance with claim 33, wherein said providing step for the
substrate module includes an assembling procedure including:
4 forming a wafer having a plurality of aligned respective channels;
6 forming another wafer having a plurality of aligned respective waveguides; and
assembling the two wafers together such that the plurality of aligned respective
channels accommodate the plurality of aligned respective waveguides.

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8 41. The method in accordance with claim 40, wherein said assembling procedure
includes filling the channels of the substrate while accommodating the waveguides.

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